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Economic Comparison of Improved and Unimproved Pastures in Producing Beef in Eastern South Dakota

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ECONOMIC COMPARISON OF IMPROVED AND UNIMPROVED PASTURES IN PRODUCING BEEF IN EASTERN SOUTH DAKOTA

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for the degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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CHAPTER I

INFORMATION PERTAINING TO THE PROBLEM

Introduction

Native pastures are not as profitable as improved pastures which are adapted to this area. The purpose of this study is to compare net returns that can be realized by farmers in eastern South Dakota when improved rather than unimproved pastures are used for the grazing of beef steers.

Farm budgets are set up for a hypothetical farm in Brookings County. One budget is made for each of five improved pastures as well as native grass. A comparison of the net returns from each improved pasture is drawn with that expected from native pasture when each pasture is grazed by yearling beef steers.[1]

Statement of the Problem

The problem is one of determining the profitability, from the whole farm standpoint, of using various improved pastures for grazing yearling beef steers compared with the

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[1]Leibel, J. L., Worzella, W. W., and Moncur, E., "Irrigated Pastures Show Substantial Gains Over Nonirrigated," South Dakota Farm and Home Research, II, Summer, 1951, p. 90.

profitability of using unimproved pasture. The value of each pasture is found for the owner-operator, the tenant and the owner of the land.

Capital limitations and the time period covered by the pasture system play parts in deciding which practices are carried out on the farm in order to obtain the maximum net income.

Objectives

1. The principal objective is to compare the profitability of using various improved pastures for the grazing of yearling steers with the profitability of grazing unimproved pastures for several typical farm situations in eastern South Dakota.
2. A secondary objective is to indicate that the length of productivity of a pasture will affect its desirability for the owner or the operator.

Need for the Study

A large number of yearling feeder cattle are shipped out of South Dakota each year. Adding weight to these cattle through grazing improved pastures could increase farm income in the state.

Information is lacking in regard to what an acre of pasture is worth in eastern South Dakota. Work has been done which reports how much beef per acre is produced; however, this is only part of what should be considered before it can be ascertained whether native pasture, improved pasture, or some other investment would be the most profitable. All costs incurred need to be considered before the relative profitability of a practice can be indicated.

Gross income and total costs determine net income from an enterprise. However, in most pasture experiments, costs are neglected. It must be remembered that some costs increase with the use of improved pastures, thus making the returns less favorable than it would appear at first glance.

It is common practice to neglect the possibility of alternative investments when the results of an agricultural experiment are published. Emphasis is not placed on the fact that even though a practice is profitable it may be suitable for one farmer while not being recommendable for a different farmer. The practice would not be desirable for those persons who could realize a higher rate of return on a different investment but lacked the capital to invest in both opportunities.

The ultimate practice decided upon will depend partially upon the financial status of the person involved.

For a person who has financial limitations, a practice would be recommended only if it rewarded the operator with a higher rate of return than any other investment open to him.

Farmers can use the opportunity cost principle in deciding where they should allocate their limited capital. This principle is applicable in indicating to each operator where he should spend his capital in order to realize the highest possible net income from his limited resources.

The amount of resource allocated to any one phase of the farm operation can differ, depending on whether the farm is owner-operated or run by a tenant. Farm owners and tenants may not realize that a farm's efficiency can be affected by the terms of their lease. Even though the same economic principles are applied by each, the level of intensification of farm practices on the rented farms may be lower than on the owner-operated farms. Similarly, the profitability of farm cropping practices and pasture plans will vary according to whether the farm is run by the owner or is rented.

The desirability of a practice depends partially on the time period over which the returns are spread. Renters may desire to be insured a profitable return within the time covered by their present lease, whereas owners are able to recover their costs and a profit over the life of the practice.

Review of Literature

Returns from land, labor, capital and, perhaps, management must all be considered together before it can be determined whether or not an alternative investment would be more profitable than a current enterprise. The individual farmer must consider the problem according to the resources available on his farm.[2] His problems are solved through analysis and action.[3]

Work by McKee, Heady and Scholl determined the optimum allocation of resources between pasture improvement and other opportunities on farms in southern Iowa. Linear programming was used to determine the optimum level of capital investment at which pasture improvement or renovation becomes more profitable than alternative investment opportunities. Particular economic considerations are discussed which cause pasture improvement to be desirable at one capital level and not at another.[4]

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[2]Long, Howard W., "Farm Management and the Best Use of Capital," Agriculture, LXVII, August, 1960, pp. 221-4.

[3]Overly, F. L., and Wheeler, R. G., "Identifying Management Alternatives," Journal of Farm Management, XXXIX, May, 1957, pp. 525-8.

[4]McKee, Dean E., Heady, Earl O., and Scholl, J. M., "Optimum Allocation of Resources between Pasture Improvement and Other Opportunities on Southern Iowa Farms," Iowa Agricultural Experiment Station Research Bulletin, Bulletin 435, January, 1956, pp. 635-63.

> A vital problem is to determine where in the farm business to invest scarce funds. To solve this problem, the farmer uses budgeting and the opportunity cost principle. Profits are maximized when each successive investment is placed where returns are the highest.[5]

The budget is a powerful tool which can be used in making decisions concerning the allocation of scarce resources. Its value lies in the fact that it permits a trial estimate before resources are committed. Flexibility of a budget permits a broad selection of conditions to be tried in the search for a desirable solution.[6]

The nature of an individual farmer's cost curve is of help in deciding whether or not to intensify production. The fact that the average cost per unit is less than the market price does not mean that intensifying production will increase the net revenue. It is much more important to know how the marginal revenue compares with the marginal cost of an additional unit. If the increase of revenue is larger than the increase of cost, intensification is profitable.[7]

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[5]Heady, E. O., and Jensen, H. R., Farm Management Economics, Englewood Cliffs: Prentice-Hall, Inc., 1957, p. 111.

[6]Fellows, Irving F., "Budgeting," University of Connecticut Agricultural Experiment Station Bulletin, Bulletin 357, August, 1960, pp. 2-10.

[7]Long, H. L., op. cit., pp. 221-4.

> The principle behind the expenditure of capital, whether long or short term, is the same for land and labor: if the return by investing it in a certain enterprise is greater than would be obtained by investing it elsewhere, then the expenditure is justified (provided it does not mean that labor is drawn away from more remunerative enterprises, or that it uses land which was already contributing more to the total income). In fact, the return to land, labor, and capital must all be considered at the same time if the most profitable arrangement of farm enterprises is to be achieved.[8]

By bringing in the realistic situation wherein the individual farmer has limited capital, it can be explained why farmers in the same soil type with the same potential increase in production and income from pasture improvement may wish to invest differently.[9]

Efficiency of a farm can be lowered by agreements between the owner and the renter of a farm.[10] The determining factor is how the variable costs are divided. The costs, or at least the direct variable costs, for each particular crop must be shared as the crop is shared.[11]

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[8] Ibid.

[9] Heady, E. O., Olson, R. O., and Scholl, J. M., "Economic Efficiency in Pasture Production and Improvement in Southern Iowa," Iowa Agricultural Experiment Station Research Bulletin, Bulletin 419, December, 1954, p. 189.

[10] Heady, E. O., "Marginal Productivity of Resources and Imputation of Shares for Cash and Share Rental Farms," Iowa Agricultural Experiment Station Research Bulletin, Bulletin 433, October, 1955, pp. 601-2.

[11] Berry, R. L., "Farm Tenancy Problems in South Dakota," South Dakota State College Bulletin, Bulletin 510, July, 1963, p. 5.

If the landlord and tenant act as though the best interest of one is not in the best interest of the other, the net product of the farm may be lower than it could be.[12]

"Logic indicates that tenants cannot afford to farm as intensely as owner-operators when they pay all of the variable costs and receive only part of the product."[13]

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[12]Johnson, O. G., "Resource Allocation Under Share Contracts," Journal of Political Economy, LVIII, No. 2, April, 1950, p. 111.

[13]Berry, R. L., "Cost Sharing as a Means of Improving the Share Rent Lease," Journal of Farm Economics, XLIV, No. 3, August, 1962, p. 803.

CHAPTER II

BACKGROUND OF THE PROBLEM

Description of the Area

The Agronomy Farm of the South Dakota State College is located in Brookings County, which lies along the eastern boundary of South Dakota.

The climate of this area is continental, which means that wide fluctuations of seasonal precipitation and temperature are normal.[1] An average precipitation of 21.62 inches is expected each year.[2] The growing season is characterized by a cool, wet spring, a hot, dry summer and a dry, cool autumn.

The Agronomy Farm has a Vienna silt loam soil. This is common soil in eastern South Dakota[3] which is found on topography which is nearly level or gently sloping.[4]

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[1]Westin, F. C., Buntley, G. J., Shubeck, F. E., Puhr, L. F., and Bergstresser, N. E., "Soil Survey of Brookings County, South Dakota," South Dakota Experiment Station Bulletin, Bulletin 468, January, 1959, p. 5.

[2]Ibid., p. 4.

[3]Puhr, L. F., "Twenty Years of Soil Management on a Vienna Silt Loam," South Dakota State College Research Bulletin, Bulletin 508, July, 1962, p. 5.

[4]Westin, F. C., Buntley, G. J., Shubeck, F. E., Puhr, L. F., and Bergstresser, N. E., op. cit., p. 45.

Methodology

Calculations within this thesis are based on a farm plan which is assumed to be somewhat typical in this area. The farm includes 360 acres, of which 10 are taken up by roadways and the building site, 200 acres are in the pasture program and the remaining 150 acres are divided equally among corn, oats and flax. The cropland and the pasture is all assumed to be tillable.

Various farm plans are drawn up to be used on this hypothetical farm. Each one is composed of practices which are common in this area.

A budget is prepared for each farm plan by listing all expected costs and income for an owner-operated farm. No charge is made for labor, as it is assumed the operator performs all the work required on any of the farm plans. The costs are further divided between the livestock and the cash crop phase of the farm plans. They are proportioned according to how much land is used for cash crops and how much is in the pasture program. There are some exceptions. These are the costs which are associated directly with cash crops or with the pasture program, and are charged to the appropriate section of the farm business.

Opportunity cost and the marginal principle are considered in the same section, for they are helpful in explaining each other. While working with these two

principles, fixed costs are considered separately.[5] Although important in deciding if a farm will be profitable in the long run, fixed costs have no effect on short-run decisions.[6] Only variable costs are used when the marginal principle is applied to specific practices. No increments smaller than those obtained from available data are used in determining the most profitable intensifying practice to use. So long as the marginal revenue is greater than the marginal cost, it will pay to operate the farm and use that proposed plan.[7]

Each farm plan shows expenditures for fixed costs and for variable costs. The goal of the farmer at each expenditure level is to gain as great a net income as possible. Therefore, each dollar is spent where the margin above opportunity cost is the greatest. The highest net revenue a farm is capable of producing cannot be realized unless adequate capital is available. This will permit each phase of the operation to be intensified until marginal revenue equals marginal cost.[8]

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[5]Heady, E. O., and Jensen, H. R., op. cit., p. 65.

[6]Boulding, K. E., Economic Analysis, New York: Harper and Brothers, 1941, p. 572.

[7]Samuelson, P. A., Economics: an Introductory Analysis, Toronto, London, New York: McGraw-Hill, 1955, p. 498.

[8]Heady, E. O., and Jensen, H. R., op. cit., p. 79.

The second economic principle to be discussed, the discounting theory, proposes that future incomes and expenses be discounted back to the present before the relative profitability of different enterprises can be compared. This principle allows pastures having different length life to be compared on the basis of present values.[9]

The present value of native grass is compared to the present value of an improved pasture (Vernal alfalfa and Ree intermediate wheatgrass), which is used in a rotation in which it is planted every fifth year. Net returns for each of the five years are discounted to their present value by a rate equal to that one would expect to pay for borrowing money plus a small rate increase due to risk. Not much charge is made for risk because the yields are an average of four years' production and are assumed to reflect some of the variations encountered in yields.[10]

Discounting was used on pasture systems in which production is expected to continue nine years after establishment. Teton alfalfa and bromegrass mixed (assumed productivity of nine years) is used as an example. The net yields over a span of ten years are discounted against those received from ten years of Vernal alfalfa and Ree intermediate

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[9]Boulding, K. E., op. cit., pp. 863-4.

[10]Heady, E. O., and Jensen, H. R., op. cit., p. 546.

wheatgrass to see which is the better investment for the owner-operator who is anticipating income for the next ten years from one type pasture or the other.

Discounting is also used in helping the farmer in making his selection of alternative capital uses when capital limitations are present. Discounting costs and returns from different plans puts them on a comparable basis so that one can decide between using money for fertilizer or using it for grazing beef on improved pasture. A pasture is chosen for the example which, it is assumed, will remain productive four years after it is established.

From an owner-operator's viewpoint, the returns from each cash crop and each type of pasture are discounted over a five-year period in order to compare the present value of each. The relative profitability of each enterprise is then indicated by their present values.

Discounting is next used to compare pastures over a ten-year period--one of which will only need to be established once in that time, while the other will need to be established twice.

The opportunity costs of investing in either fertilizer or pasture production are calculated, and they are used for the discount rates when the present values of the net incomes of the alternative investments are determined. This is an important principle when capital is a limiting factor.

Up to this point, the discussion has centered around what an owner-operator would do. Tenants may allocate resources in different amounts than an owner-operator would.[11]

Different lease situations are considered as to their effect on how the owner and the renter would desire to allocate their resources on the same farm which was earlier considered as being owner-operated.[12]

The marginal theory for maximum profit and the discount principle are used to determine how the renter and the owner would allocate their resources and which practice would be the most profitable for each.[13]

Source of Data

A pasture study has been conducted since 1960 by the Agronomy and Animal Science departments of South Dakota State College. Yearling beef steers have been grazed on the following four types of improved pastures: bromegrass and Vernal alfalfa, intermediate wheatgrass and Vernal

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[11] Hurlburt, V. L., "Farm Rental Practices and Problems in the Midwest," Iowa Agricultural Experiment Station Research Bulletin, Bulletin 416, October, 1954, pp. 85-90.

[12] Heady, E. O., op. cit., p. 601.

[13] Heady, E. O., Economics of Agricultural Production and Resource Use, New York: Prentice-Hall, Inc., 1952, pp. 326-8.

alfalfa, bromegrass and Teton alfalfa, and intermediate wheatgrass and Teton alfalfa.

Four replicas of each pasture type were grown during each of the four years' production considered. The resulting pounds of beef per acre are used in this paper when working out budgets for the hypothetical farm.[14]

The same type of information was secured in similar pasture trials conducted from 1954 to 1957 by the Agronomy and Animal Science departments of South Dakota State College. From this data, the yield in pounds of beef per acre was ascertained for soybean and sudangrass pasture.

Pasture yields in terms of animal products per acre are considered to be the most accurate way of reporting pasture returns.[15]

Stocking rates for native pastures were secured from the Technical Guide for South Dakota.

Due to the wide variation in conditions of native ranges, care must be taken in accepting the budgeting analysis concerning income from native grass. Expected yields will vary from 1.05 animal unit months per acre (an animal

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[14]Bradford, L. A., and Johnson, G. L., Farm Management Analysis, New York: Wiley, 1953, p. 366.

[15]Lynd, J. I., Graybill, F., and Totusek, R., "Factors Affecting Results of Grazing Trials with Yearling Steers," Agronomy Journal, XLVIII, August, 1956, p. 352.

unit month is the amount of pasture required to feed one mature cow or equivalent for one month) to .15 animal unit months per acre, depending on the precipitation belt, site and range conditions.[16]

For the purpose of this study, the pasture was considered as being in 75% condition and as being located on soil and topography similar to that of the South Dakota State College Agronomy Farm. Animals grazing on a range in 75% condition could be expected to make daily gains as good as those obtained from alfalfa-brome pasture during a comparable growing season. On range of this condition, cattle should probably only be grazed from June to August.[17]

Yields of small grain and corn, as well as rates of fertilizer applied, were taken from the bulletin, "Twenty Years of Soil Management on a Vienna Silt Loam." The work was conducted by Dr. Leo Puhr, former professor of Agronomy at South Dakota State College.

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[16] Technical Guide for South Dakota, Developed by the Soil Conservation Service in cooperation with other agencies of the U. S. Department of Agriculture, the U. S. Department of Interior, South Dakota State College, and cooperating state agencies, 1961, Sec. II, E, and III, D.

[17] According to personal interview with J. Lewis, Associate Professor, Animal Science, South Dakota State College.

Prices of crops and cattle were secured from "South Dakota Agriculture," South Dakota Crop and Livestock Reporting Service, and the U. S. Department of Agriculture.

Most other costs and figures are the same as those used in a budget analysis of Oahe project, central South Dakota.[18]

The data which was not secured from one of the previous sources is designated as being assumed within the text of the thesis.

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[18]Helfinstine, Rex D., "Economic Comparison of Irrigation and Dryland Farming in Central South Dakota," South Dakota Agricultural Experiment Station Bulletin, Bulletin 518, 1964.

CHAPTER III

OPPORTUNITY COST PRINCIPLE AS APPLIED BY OWNER-OPERATORS

Theoretical Considerations

The opportunity cost principle can be used for comparing practices and enterprises on the farm as a whole. It is the value of one product sacrificed because resources were used in the production of a more profitable alternative. The maximum opportunity cost of allocated capital is the amount which could have been earned from the next best alternative.[1]

If a farmer has unlimited capital, he does not use the opportunity cost principle to decide which and how much of a commodity to produce. He simply takes each product he is producing and expands its production as long as each unit of added cost produces a profit.[2]

Most farmers do have limited capital, as well as a limited amount of land. When this type of operator decides to use a resource in the production of one product, it means he will be producing less of another product.[3]

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[1] Heady, E. O., and Jensen, H. R., op. cit., p. 108.

[2] Ibid., p. 77.

[3] Beneke, R. R., Managing the Farm Business, New York: Wiley, 1955, pp. 313-4.

The opportunity cost for a given enterprise is the net returns if the same resources were used in the next most profitable alternative.

Given the need for some combination of enterprises, as well as the fact that a farmer has limited capital and land, it must be decided where each unit of resources will bring the greatest return.[4] Profits will be highest when each unit of available resource is used where it will bring the largest marginal or added returns.[5]

Frequently costs of an operation are divided into fixed and variable costs. Fixed costs are those which must be paid whether the business is in operation or not, and variable costs are those which are incurred only when the unit is operated.[6] If gross income exceeds the variable costs but not total costs, it is best to operate the business in the short run, for the portion of the income which exceeds variable costs will offset part of the fixed costs. As a result, the loss will not be as great as it would have been if the business had not been operated.[7] Over the long

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[4]Heady, E. O., Olson, R. O., and Scholl, J. M., op. cit., p. 185.

[5]Nerlove, M., The Dynamics of Supply: Estimation of Farmers' Response to Price, Baltimore: John Hopkins Press, 1958, p. 30.

[6]Bishop, C. E., and Toussaint, W. D., Agricultural Economic Analysis, New York: Wiley, 1958, p. 70.

[7]Boulding, K. E., op. cit., p. 572.

run, gross income would need to be greater than the variable costs plus the fixed costs in order for the business to continue in operation and yield a profit.[8] Variable costs are the sole consideration in deciding how much should be produced.[9]

Applicability to the Problem

The problem in this thesis is not in deciding if the farm should operate. More explicitly, the problem revolves around the question of how resources should be used in order to obtain the highest net income for farmers having various levels of capital. It is a matter of dividing the resources between the cash crop enterprises and the livestock phase of the operation.

The number of acres used for each crop, as well as the number of acres in pasture, remains the same in each plan. It is assumed that the costs of all improved pastures are identical as is the net income derived from cash crops in each of the budgets in which improved pastures are considered.

The net income from each type of improved pasture is expressed as a percent return on the investment of each

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[8] Bishop, C. E., and Toussaint, W. D., op. cit., p. 70.

[9] Heady, E. O., op. cit., p. 680.

improved pasture. (Table 3.1) The returns from native pasture, as well as those from a combination of fifty acres of soybeans and sudan plus fifty acres of native pasture, are also presented as a percent return on the required investment. Returns given as a percent return on investment are meaningful because no plan is considered which has other than 200 acres diverted for pasture use, while the rest of the farm is used for the production of cash crops. Therefore, fixed costs are set according to the amount of land used in each phase of the total operation, and they do not change from plan to plan.[10] This means the return on investments will be affected only by the variable costs and the expected returns on each part of the operation.

On the basis of the budgets for each of the improved pastures, it is evident that the highest net income can be obtained by growing Vernal alfalfa and intermediate wheatgrass mixture, which yields a net income of $2,960. The opportunity cost for each of the other pastures would be $2,950, $2,810, and $2,420, respectively, corresponding to the net incomes which could be realized had one of the other improved pastures been selected.[11]

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[10] Heady, E. O., and Jensen, H. R., op. cit., p. 65.

[11] Castle, E. N., and Becker, M. H., Farm Business Management: the Decision-making Process, New York: MacMillan Company, 1962, p. 57.

Table 3.1 Comparison of Costs and Returns from Various Improved Pastures and Native Grass.

Kind of Pasture	Gross Sales from Pasture	Expense on Pasture*	Net Sales from Pasture	Rate of Return on Pasture Expense**
	(dollars)	(dollars)	(dollars)	(percent)
Vernal Alfalfa and Brome	31,770	28,820	2,950	10.23
Teton Alfalfa and Brome	31,240	28,820	2,420	8.39
Vernal Alfalfa and Intermediate Wheatgrass	31,780	28,820	2,960	10.27
Teton Alfalfa and Intermediate Wheatgrass	31,630	28,820	2,810	9.75
Sudangrass and Soybeans 50 acres, Native Grass 150 Acres	11,830	11,310	520	4.59
Native Grass	10,500	10,290	210	2.04

*Expenses on pasture--based on seed, 180 pounds of 0-45-0 fertilizer per acre, cattle purchase price of $27.40 and selling price of $23.48 per hundred pounds, veterinarian cost of one dollar per steer, salt cost of 17 cents per steer, 4/7 of total building inventory, 1/4 of machinery depreciation, and short term interest on all of the foregoing items plus 4/7 of the real estate tax on machinery, insurance on cattle and inventory charged to cattle, and 4/7 of the real estate tax.

**Rate of return on pasture expense is derived by dividing the net sales from pasture by the expense on pasture.

The budget with Vernal alfalfa plus intermediate wheatgrass indicates how much the farm can return if it is assumed that the operator has ample capital to invest in the improved pasture and that he applies fertilizer at the rate of 60 pounds of 33-0-0 plus 40 pounds of 0-45-0 on each acre of corn and if he applies 60 pounds of 33-0-0 on each acre of oats and no fertilizer on the flax.[12]

The question arises: would this be the most profitable way to manage the farm for operators having other levels of capital?

In order to answer this question, marginal costs and marginal revenue must be considered along with opportunity costs of investments for various levels of available capital.[13]

In this section of the thesis it will be assumed that the farm is owner-operated for each budgetary plan of operation drawn up. The same number of acres will be devoted to the various phases of operation for each proposed budget.

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[12]Symbols 33-0-0 and 0-45-0 refer to the chemical analysis of two fertilizers: 33% N (total nitrogen) and 45% P_2O_5 (available phosphoric oxide), respectively.

[13]Heady, E. O., and Jensen, H. R., op. cit., p. 78.

This will allow the fixed costs of the operation to be prorated according to how much each acre is a part of the total operating costs.[14]

When maximum net revenue is desired, the problem is a continuous one of using the available resources where they will bring in the highest returns.[15] Choices need to be made as available capital increases by comparing costs with marginal returns of available alternative investments.[16]

Certain costs listed in the budget need to be considered before any operating costs are calculated.[17] Fixed costs include: real estate tax, interest on investment and depreciation which amount to $808 on the pasture and $706 on the rest of the operation. Variable costs include: seed, fertilizer, cost of cattle, personal property tax beyond the fixed personal property tax, insurance, repairs on machinery, fuel, and short-term interest. These will vary according to the practices proposed in the budgets.

At the lowest level of capital considered, the practices will be followed which require the least capital to

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[14] Ibid., p. 65.

[15] Hare, H. R., Farm Business Management, Toronto: Ryerson Press, 1946, pp. 187-8.

[16] Heady, E. O., Olson, R. O., and Scholl, J. M., op. cit., p. 185.

[17] Beneke, R. R., op. cit., p. 225.

put them into operation while yielding the highest returns.[18] The first $1568 of capital is required to pay the fixed costs on each proposed budget. Capital beyond this amount must be considered according to the marginal net revenues and opportunity costs of alternative investments.[19] It will be invested in the alternative possessing the greatest margin above opportunity cost.[20]

Average returns per dollar of variable cost required for 50 acres of various crops and 200 acres of pasture are presented in table 3.2. Flax returns $7.72 for each dollar spent on it when no fertilization program is practiced, whereas corn and oats return $6.11 and $7.10, respectively. Native pasture is present on the farm. According to the budget plan, where native pasture is grazed by yearling beef steers, the average return for each dollar spent on steers would be $1.12.

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[18] Heady, E. O., Olson, R. O., and Scholl, J. M., op. cit., p. 189.

[19] Beneke, R. R., op. cit., p. 275.

[20] Castle, E. N., and Becker, M. H., op. cit., p. 58.

If only $500 of capital beyond that required for fixed costs were available, not all of the practices could be carried out.[21] The first $253 would be spent on flax, because that crop shows the highest return. The remainder of the $500 would be used for the production of oats, which has the next highest return.

Each dollar spent on flax has an opportunity cost which could have been earned by investing in corn, oats or cattle. In each case the amount that could have been earned from any of the other investments is expressed by the average return on a dollar invested. Maximum revenue is obtained when each dollar is allocated to the phase of the farm operation returning highest average returns per unit of variable cost, which in this case is $253 for the production of flax, $175 for oats and the remainder is allocated for corn.

In this budget plan, the number of dollars allocated to a given crop is governed by the number of acres of the crop raised and the required variable costs. The remaining capital is spent on the crop having the next highest opportunity cost. As mentioned earlier, at the $500 capital level, not all of the farm land could be utilized by the operator because of a shortage of operating capital. The

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[21] Bishop, C. E., and Toussaint, W. D., op. cit., p. 70.

Table 3.2 Average Returns per Dollar of Variable Cost for Various Crops and Native Pasture without Fertilizer (From 50 acres of crops or 200 acres of pasture)

	Unit	Flax	Corn	Oats	Native Pasture
Fixed Cost[a]	dollars	253	253	253	808
Variable Cost[b]	dollars	235	336	172	9378
Yield per Acre	bushels	11.6	45.7	48.9	
Returns[c]	dollars	1815	2056	1222	10,496
Average Returns per Dollar of Variable Cost[d]	dollars	7.72	6.11	7.10	1.12

[a]Includes depreciation costs, real estate and personal property taxes, insurance, and interest on investment.

[b]Includes seed, repairs, fuel, and interest on investment for crops. Cost of cattle and veterinarian costs of one dollar per head are added to complete the variable expenses on pasture.

[c]All figures refer to costs or incomes realized from 50 acres in each crop and 200 acres of native pasture.

[d]Calculated by dividing gross returns by variable cost. The figure indicates how much is returned for each dollar spent on variable costs.

capital limitations whould leave 36 acres of the corn ground and all of the native pasture to be rented out because of insufficient funds to allow the operator to realize their production potential.

An addition of $500 to the available capital would pose further problems in deciding where it should be spent. The first $239 would be spent on corn, which would satisfy the variable costs of raising 50 acres of corn. The remaining $261 should be used where it will return the maximum revenue. Alternative investments could be for fertilizer or for the purchase of cattle to be grazed on the native pasture. The average returns from investing a dollar on fertilizer at the levels considered in table 3.3 are $1.56, $.44 and $3.25, respectively, for flax, corn and oats. Previously it was found that the average return on native grass is $1.12 for each dollar invested.

Using the marginal principle as a guide, the capital would be spent in the following manner: the first $120 would be spent on nitrogen for flax, and the remaining $21 spent on nitrogen and superphosphate fertilizer for corn. The lack of capital would mean that 45 acres of the corn would not receive any fertilizer.

An increase of $500 of capital, making a total of $1500 available for variable costs, would permit further

Table 3.3 Average Returns per Dollar of Fertilizer Cost for Various Crops (from 50 acres)

	Flax	Corn	Oats
Fertilizer Used	60# 33-0-0	60# 33-0-0 44# 0-45-0	60# 33-0-0
Fertilizer Cost	$120	$213	$120
Change in Yield per Acre*	1.2 bushels	6.8 bushels	15.6 bushels
Total Bushel Yield Change**	60 bushels	340 bushels	780 bushels
Change Total Revenue***	$187.80	$306	$390
Average Returns per Dollar of Fertilizer	$1.56	$1.44	$3.25

*The addition of the indicated number of pounds of fertilizer per acre listed in the row entitled "fertilizer used" changes the yield per acre by the amount given in the row "change in yield per acre."

**Figures in row "total bushel yield change" refer to the added bushels produced on 50 acres when the indicated amount of fertilizer is used.

***Prices of grain per bushel are: oats, $.50; corn, $.90; and flax, $3.13.

changes in the proposed budget. One hundred and ninty-two dollars will be spent on fertilizer for corn, which has average returns of $1.44 for the use of fertilizer at previously given rates. This leaves $308 to be allocated. The choice falls among more fertilizer, the purchase of cattle, pasture improvement or for investments outside of the farm. Pasture improvement is dismissed, for it will not be considered a possibility until enough capital is available to utilize 50 acres of soybean and sudangrass.[22]

Table 3.4 illustrates what happens when an additional 60 pounds of ammonium nitrate fertilizer per acre is added on the cash crops. The total ammonium nitrate fertilizer would now be 120 pounds.

In each case the average cost exceeds the change in returns. It would not be profitable to apply an extra 60 pounds of 33-0-0 on any of the grain.[23] No level of additional fertilizer application smaller than 60 pounds per acre increments is considered because the yield data were

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[22]McKee, D. E., Heady, E. O., and Scholl, J. M., op. cit., p. 635.

[23]Boulding, K. E., op. cit., p. 551.

Table 3.4 Average Returns from Second Increment of Fertilizer.*

	Fertilizer Cost[a]	Change in Yield, Bushels[b]	Total Change, Bushels[c]	Change in Returns[d]
Flax	$120	- .6	- 30	-$93.90
Corn	$120	1.1	55	$49.50
Oats	$120	3	150	$75.00

*Increments of 60 pounds of ammonium nitrate.

[a]Gives the additional cost of applying the increment of fertilizer to 50 acres.

[b]Refers to the number of bushels per acre the yield changes with added fertilizer.

[c]Gives total bushel change for 50 acres.

[d]Gives net change in returns for 50 acres.

not available for the area under consideration.[24] Theoretically it would be feasible to keep adding fertilizer to the crops until the cost of the last increment equaled the marginal revenue produced by the increment.[25] That is not possible in this case because the yield information is not sufficient to form a continuous function.[26]

The choice of where to use the $300 left from the $1500 available for variable costs is narrowed down to either buying yearling steers or investing on the open market. Marginal returns from the grazing of yearling beef steers is $1.12 which is more than the assumed marginal returns of $1.06 obtainable on the open market for each dollar invested. Therefore the $308 is invested in the project of grazing yearling beef steers, and the pasture not needed by them is rented. More steers would be purchased as the level of capital increased until the capital available for variable costs amounted to $10,666, of which $1,192 would be allocated for grain production and the remaining $9,474 for the

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[24]Puhr, L. F., op. cit., pp. 2-31.

[25]Bach, L. B., Economics: An Introduction to Analysis and Policy, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1957, p. 434.

[26]Boulding, K. E., op. cit., p. 541.

purpose of utilizing native pasture. Available capital beyond this level would be invested in the open market where returns are assumed to be six percent.

When sufficient funds are available, a sudangrass and soybean pasture could replace part of the native pasture. This is a supplemental pasture to be used during the summer,[27] and its productivity is greater than native grass.[28] According to budgeting figures, 50 acres of sudangrass and soybean pasture would mean an additional cost of $1030 over and above what native pasture would cost. The added revenue from this pasture would be $1,547 and the average returns per dollar from the $1030 invested in sudangrass and soybean pasture is $1.50.

A total capital level of $14,450 would be allocated accordingly: $808 for fixed cost of pasture program, $760 for fixed costs of cash crops, $1,196 for variable costs of cash crops, $11,696 for variable costs of 150 acres of native grass and 50 acres of sudangrass and soybean pasture. Beyond this level, capital would again be invested in the open market until $30,776 are available. The foregoing

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[27]Hughes, H. O., Heath, M. E., Metcalfe, D. S., Forages: The Science of Grassland Agriculture, Ames: Iowa State University Press, 1962, p. 356.

[28]Worzella, W. W., Embry, L. B., Wetzal, F., "Pastures in Eastern South Dakota Can Be Profitable," South Dakota Farm and Home Research, IX, No. 3, May, 1958, pp. 23-7.

plan called for an investment of $14,450. This figure subtracted from $30,776 leaves $16,326 which is enough to allow the farm to utilize 200 acres of improved pasture instead of the previous pasture combination.

The choice now presents itself--which alternative investment for the extra $16,326 of available capital offers the highest returns? Should improved pasture be used or should the money be invested on the open market? Marginal costs of $16,326 will return $19,937 for 200 acres of intermediate wheatgrass and Vernal alfalfa, $19,407 for bromegrass and Vernal alfalfa, $19,951 for intermediate wheatgrass and Teton alfalfa, and $19,769 for bromegrass and Teton alfalfa. The average returns from each pasture, respectively, are $1.69, $1.64, $1.68 and $1.67 for each of the $16,326 invested in an improved pasture. Each pasture returns greater average returns than the identical amount of capital would on the open market. It would be economically feasible to change over to an improved pasture rotation.[29]

Further additions of resources may yield average returns greater than their costs, but because of limitations of yield data, further computations on the average value of

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[29]Heady, E. O., and Jensen, H. R., op. cit., p. 78.

resources cannot be carried out. For this size and type of farm, a capital level of $30,776 can be invested profitably.[30]

Care must be taken that capital is not allocated to a section of the farm operation simply because it returns the highest average return on total variable costs.[31] The manager must go beyond this stage and compare the additional costs as well as the added production he will realize when more intensive farming practices are put into action.[32] For example, consider the returns from flax, corn and oats when they are unfertilized with the returns when fertilizer is applied. (table 3.5)

When no fertilizer is used, flax returns $7.72, corn $6.11 and oats $7.10 on each dollar of variable cost. The operator who checks only these results may be led to believe that flax is the best place for him to allocate additional capital. This would be true if it were possible to expand while maintaining all variable and fixed costs at the levels where they are in this situation.[33]

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[30] Bach, L. B., op. cit., p. 434.

[31] Knight, D. A., and Greve, R. W., "Use and Interrelation of Marginal Analysis to Other Analytical Processes by Farmers in Decision-making Theory," Kansas Agriculture Experiment Station Technical Bulletin, Bulletin 108, 1959, pp. 1-47.

[32] Heady, E. O., and Jensen, H. R., op. cit., p. 69.

[33] Ibid., p. 450.

Table 3.5 Comparison of Returns per Dollar of Variable Cost with Returns per Dollar of Fertilizer Cost.

	Total Variable Cost[d]	Fertilizer Cost[d]	Average Return per Dollar of Variable Cost	Average Return per Dollar of Fertilizer Cost
Flax[a]	$235		$7.72	
Corn[a]	$336		$6.11	
Oats[a]	$172		$7.10	
Flax[b]	$355	$120	$5.64	$1.56
Corn[c]	$549	$213	$4.30	$1.44
Oats[b]	$292	$120	$5.55	$3.25

[a]No fertilizer

[b]Fertilized at rate of 60 # 33-0-0 per acre

[c]Fertilized at rate of 60# 33-0-0 and 44# 0-45-0 per acre

[d]Gives the variable costs associated with 50 acres of flax, corn or oats

However, in this thesis, one of the assumptions is that the number of acres is held constant for a certain crop for each plan. Therefore, expansion is ruled out. The final decision rests upon which intensification practice will yield the greatest returns over costs.[34] These cannot be ascertained until the additional costs of fertilizer and the average returns derived thereof are compared.

The most profitable investment alternative would be that of investing in fertilizer for oats, which will return $3.25 for each dollar invested in it; whereas corn yields $1.44 and flax $1.56 for each dollar of fertilizer cost.[35]

If more capital were available than needed for the 50 acres of oats, the next increment of capital would be spent on ammonium nitrate for corn, which has the next highest rate of return on fertilizer investment.

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[34] Ibid., p. 458.

[35] Ibid., p. 78.

CHAPTER IV

DISCOUNTING PRINCIPLE

Theoretical Considerations

The discounting principle is built around the economic theory that a dollar today is worth more than a dollar next year.[1] This is not due to uncertainty, but it is because a dollar which one has today can be invested so that it will be bringing in returns during the following year.[2]

If a farmer has unlimited capital within his means, the relevant rate of interest for discounting purposes is whatever the market rate of interest happens to be.[3] This is the case because he can invest in all of the alternatives which will yield higher returns and still have money left to invest on the open market.

When we bring in the situation of the individual farmer having limited capital, we can explain why farmers on the same soil type with the same potential increase in

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[1]Haynes, W. W., Managerial Economics: Analysis and Cases, Homewood, Illinois: Dorsey Press, Inc., 1963, p. 28.

[2]Bishop, C. E., and Toussaint, W. D., op. cit., p. 142.

[3]Heady, E. O., and Jensen, H. R., op. cit., p. 88.

production and income may choose to invest differently.[4]

The farmer operating with limited capital will want to consider the alternative uses of money in his own business. For him, the proper discount rate for profit calculations is the opportunity cost of not using the money in the next most profitable enterprise.[5]

The discount principle allows the operator to decide whether or not he should set up a practice which would require a large outlay of capital at the beginning but will be productive for a number of years.[6] By discounting all expected returns at the appropriate rate, he is able to compare the present value of the future income with the present costs, thus determining how profitable the venture would be.[7]

The capital limitations of the operator decide what opportunity cost or discount rate he will use, and the

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[4]Heady, E. O., Olson, R. O., and Scholl, J. M., op. cit., p. 189.

[5]Heady, E. O., and Jensen, H. R., op. cit., p. 88.

[6]Ibid., p. 355.

[7]Bishop, C. E., and Toussaint, W. D., op. cit., pp. 143-4.

capital level determines how near the operator can come to the point where marginal revenue equals marginal cost.[8]

In general, farmers do not use capital until marginal cost equals marginal revenue. As a result, their returns on additional capital may be greater than the market rate of interest.[9] This means that an investment over a number of years which is equally profitable for two operators may be desirable for one but not the other because they use different discount rates depending on their capital position.[10]

Application to the Problem

Consider the example of the hypothetical farm plan where 200 acres of native pasture plus 150 acres of cash crops are the income-producing units on the farm.

The lowest capital position to be considered will be the one in which native pasture is grazed by yearling

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[8]Beneke, R. R., op. cit., p. 275.

[9]Heady, E. O., and Jensen, H. R., op. cit., pp. 572-3.

[10]Ibid., p. 88.

beef steers, all the cash crops are fertilized with 60 pounds of ammonium nitrate and corn receives 44 pounds of super phosphate in addition to the nitrogen. This operation requires $13,420 to cover all fixed and variable costs beyond the ownership costs of the land.

The question arises as to how much would 50 acres of improved pasture--Vernal alfalfa and intermediate wheatgrass mixture--need to return over five years in order for it to compete with 50 acres of native pasture for the available capital, and what are the returns from each when discounted to present value.

Before this problem can be solved, the expected net returns from both types of pastures for the following five years need to be discounted to the present value for each.[11]

Figures from the budget for the farm plan where native pasture is used indicate that a net return of $52.50 can be expected from 50 acres of native pasture yearly.

In order to find the present value of net returns

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[11] Bishop, C. E., and Toussaint, W. D., op. cit., p. 142.

from five years of native pasture, the discount equation used, which is:[12]

$$PV = \frac{R}{1+r} + \frac{R}{(1+r)^2} + \cdots \frac{R}{(1+r)^5}.$$

PV = the present value of expected income after it is discounted.
R = the net income for each year.
r = the amount which could be earned on the open market, plus a charge for risk of 2%.[13]

$$PV = \frac{\$52.50}{1+.08} + \frac{\$52.50}{(1+.08)^2} + \frac{\$52.50}{(1+.08)^3} + \frac{\$52.50}{(1+.08)^4} + \frac{\$52.50}{(1+.08)^5}$$

PV=$48.61 + $45.25 + $42.00 + $38.88 + $36.20 = $210.94.

Results from the budget are not entirely representative of the costs incurred when 50 acres of Vernal alfalfa and intermediate wheatgrass are planted on renovated soil. Additional charges for machinery repair and fuel charges are incurred when grass must be seeded on renovated pasture rather than on previously tilled ground. The extra charge for pasture renovation is assumed to be three times greater than the fuel and repairs would have been for planting 50 acres of pasture in a regular crop rotation.[14]

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[12] Ibid.

[13] Heady, E. O., and Jensen, H. R., op. cit., pp. 546-8.

[14] Total of fuel and repairs for tractor, plow, drill, and drag are $199.80. Of this, ¼ would have been attributed to 50 acres. This now multiplied by three equals $149.85; when rounded to nearest dollar it is $150.

During the first year of the pasture improvement phase, no income is realized from the new seeding, but an opportunity cost of $52.50 from the foregone grazing of native pasture should be charged.[15] To this charge, the additional cost of establishment must be added and the total is the total cost the year of establishment. A fertilizer cost of $228 plus $150 for establishment plus the opportunity cost of $52.50 totals $430 for the first year.

The budget using Vernal alfalfa and intermediate wheatgrass for pasture indicates the 50 acres will yield a net revenue of $741, which is the expected income, and must be discounted by the same discount rate used in discounting native pasture net revenue in order to compare the present values of the two investments.[16]

The following equation needs to be solved in order to determine the present value of utilizing 50 acres of improved pasture.

$$PV=\frac{-\$430}{1+.08}+\frac{\$741}{(1+.08)^2}+\frac{\$741}{(1+.08)^3}+\frac{\$741}{(1+.08)^4}+\frac{\$741}{(1+.08)^5}$$

$$PV=-\$398+\$638+\$592+\$548+\$511=\$1891$$

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[15] Heady, E. O., and Jensen, H. R., op. cit., p. 77.

[16] Bishop, C. E., and Toussaint, W. D., op. cit., p. 143.

The present value for improved pasture gains over a five-year period is $1891; whereas the present value of native pasture gains during the same period is $210.94.

These figures are the present values of the net incomes after they have been discounted. They are the total income of the five years' income beyond all costs, including both fixed and variable. On the basis of these figures, a pasture mixture of intermediate wheatgrass and Vernal alfalfa would be a better-paying investment than native pasture.

Suppose the choice as to which would be the better pasture investment fell between either Vernal alfalfa and bromegrass or Teton alfalfa and bromegrass. Before deciding on one or the other, two assumptions would need to be considered which will affect the numerical values and equations used: (1) Vernal alfalfa and brome is the greater yielder of the two. (2) Teton alfalfa and brome is assumed to remain productive longer than Vernal alfalfa and brome.

A pasture mixture of Vernal alfalfa and smooth bromegrass can be assumed to outyield a similar pasture made up of Teton alfalfa and brome. In a four-year test at South Dakota State College, Vernal and brome produced 212 pounds of beef per acre; whereas Teton and brome produced 200

pounds of beef per acre when grazed by yearling beef steers.[17]

When these two pastures are used in a rotation where they are plowed up every five years, Vernal and brome shows a net return of $132 per 50 acres of pasture greater than Teton and brome. This price differential is based on a beef price of $23.48 per hundredweight.

As was indicated, Teton alfalfa and brome is assumed to last several years longer than Vernal and brome. This allows the operator a choice between pasture rotation systems.

For example, suppose he wants to determine which would be the better investment: Teton and brome, which is assumed to remain productive for nine years; or Vernal and brome, which is assumed to require reseeding every fifth year.

This problem can be solved by discounting the expected net returns of both pastures over the length of time involved.[18]

Costs of establishment for both pastures can be assumed to be the same during the first year. These are:

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[17] Moore, R., and Wetzal, F., according to personal interview.

[18] Bishop, C. E., and Toussaint, W. D., op. cit., pp. 142-5.

$430 for a 50-acre pasture, which is accounted for by fuel, repairs, seed, fertilizer and the opportunity cost of not producing native grass during the year of establishment.[19] During the sixth year $906 must be charged against the Vernal alfalfa and brome pasture, due to re-establishment costs plus the opportunity cost of a year's production lost during re-establishment.[20]

Net revenue from 50 acres of Teton and brome is $605, whereas Vernal and brome pasture produces $737 of net revenue. These figures need to be discounted in order to determine the present values of the alternative investments.[21]

Substitution in the discount equation gives the following results for the present value of ten years' pasture of Teton and brome:

$$PV=-\frac{\$430}{1+.08}+\frac{\$605}{(1+.08)^2}+\frac{\$605}{(1+.08)^3}+\frac{\$605}{(1+.08)^4}+\frac{\$605}{(+.08)5}+$$

$$\frac{\$605}{(1+.08)^6}+\frac{\$605}{(1+.08)^7}+\frac{\$605}{(1+.08)^8}+\frac{\$605}{(1+.08)^9}+\frac{\$605}{(1+.08)^{10}}=$$

$2873.

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[19] Heady, E. O., and Jensen, H. R., op. cit., p. 79.

[20] Ibid.

[21] Haynes, W. W., op. cit., p. 29.

The net incomes over ten years of Vernal and brome pasture are discounted as follows:

$$PV = \frac{-\$430}{1+.08} + \frac{\$737}{(1+.08)^2} + \frac{\$737}{(1+.08)^3} + \frac{\$737}{(1+.08)^4} + \frac{\$737}{(1+.08)^5} + \frac{-\$906}{(1+.08)^6} + \frac{\$737}{(1+.08)^7} + \frac{\$737}{(1+.08)^8} + \frac{\$737}{(1+.08)^9} + \frac{\$737}{(1+.08)^{10}} =$$

$2873.

After discounting is completed on both types of pasture, it is evident that Teton and brome has a higher present value and it would be the better investment.[22] This is the case even though it has a lower net return per year.

Consider the situation discussed previously: sufficient capital had been available to allow proper fertilization of the oats and flax, but the capital was $213 short of what is required in order to fertilize the corn. Now assume the additional capital supply of $6,770, of which $213 has an opportunity cost of 44% when spent on one increment of nitrate and one of phosphate fertilizer for corn.

The problem is one of deciding whether the entire $6,770 should be allocated to improving pasture and buying cattle to utilize the pasture; or should $213 be spent on fertilizer, and the remainder invested in the pasture project.[23]

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[22] Ibid.

[23] Ibid., p. 79.

If the decision is to invest in the Teton and brome-grass pasture, the net returns for the following ten years must be discounted by 44%, which is the opportunity cost of not investing in fertilizer for corn.[24] The returns which could be earned by fertilizing would be discounted over a ten-year period with the opportunity cost of the $213 when invested in pasture.[25]

As determined previously, an investment of $27,950[26] in Teton and brome pasture will give net returns of $2,810 for nine years after the first year of establishment. The following equation will indicate how much $213 will return if spent on the pasture project.

$$\frac{\$27,950}{\$2810} = \frac{\$213}{x} = \$21.41$$[27]

Then the opportunity cost of investing in cattle can be calculated by dividing the change in revenue ($21.41) by $213 (capital needed for fertilization).

$$\frac{\$21.41}{\$213} = 10.05\% \text{ return on investment}$$

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[24] Ibid.

[25] Ibid.

[26] The total cost figure of $27,950 is a result of adding $27,850, which is the variable cost of producing 200 acres of improved pasture in a rotation, to $100, which is the extra cost of breaking up native sod and establishing improved pasture.

[27] Equation set up as a direct proportion which reflects that if $27,950 returns $2810, then $213 could be expected to return $21.41.

The opportunity cost of investing the $213 on pasture production is 10.05%.[28]

After the opportunity cost of investment in pasture is determined, that rate is used to discount the net annual returns of $340 which could be realized if the $213 were invested each year in fertilizer for ten years. The discount rate used is the opportunity cost of investing in native pasture, as found above.

$$PV=\frac{\$340}{1+.10}+\frac{\$340}{(1+.10)^2}+\frac{\$340}{(1+.10)^3}+\frac{\$340}{(1+.10)^4}+\frac{\$340}{(1+.10)^5}+$$

$$\frac{\$340}{(1+.10)^6}+\frac{\$340}{(1+.10)^7}+\frac{\$340}{(1+.10)^8}+\frac{\$340}{(1+.10)^9}+\frac{\$340}{(1+.10)^{10}}=$$

$2094.[29]

The next step is to discount the net revenue obtained when $213 is invested in pasture. The opportunity cost of investing the capital on fertilizer for corn is the discount rate.

$$PV=\frac{\$21.41}{1+.44}+\frac{\$21.41}{(1+.44)^2}+\frac{\$21.41}{(1+.44)^3}+\frac{\$21.41}{(1+.44)^4}+\frac{\$21.41}{(1+.44)^5}+$$

$$\frac{\$21.41}{(1+.44)^6}+\frac{\$21.41}{(1+.44)^7}+\frac{\$21.41}{(1+.44)^8}+\frac{\$21.41}{(1+.44)^9}+\frac{\$21.41}{(1+.44)^{10}}=$$

$32.57.[30]

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[28]Heady, E. O., and Jensen, H. R., op. cit., p. 357.

[29]Haynes, W. W., op. cit., p. 29.

[30]Ibid.

The foregoing example is an extreme case which reveals the importance of determining the most profitable investment in line with alternatives and present value. Even though both were profitable, the same amount of money invested in the alternative having the highest opportunity cost yields by far the greatest present value when the anticipated incomes are discounted over time.[31]

It is evident that capital limitations magnify the importance of placing capital in ventures which have the highest opportunity cost.[32] Whenever lack of capital prevents some alternative investments being made, it is the opportunity costs of the investments having the highest returns which must be considered as the discount rate.[33] If the operator is hampered by an extreme lack of capital, his opportunity costs will be much higher than the market rate of interest.[34]

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[31] Heady, E. O., and Jensen, H. R., op. cit., p. 78.

[32] Ibid.

[33] Ibid.

[34] Ibid.

CHAPTER V

EFFECTS OF TENANCY ON USE OF IMPROVED PASTURES

Theoretical Considerations

Farm tenancy involves an agreement whereby the tenant gains the use of land and the owner obtains the services of an operator. They agree to a lease, written or oral, which specifies the use of resources and the payment to be received by each.[1]

"The type of farm lease can either aid or retard efficiency in farming."[2] Conditions can be present in the lease which will cause resources to be used in a manner such as is not compatible with seeking the highest profit combination for the combined resources of owner and tenant.[3]

"Principles of economic analysis apply the same whether all resources are in one ownership or are split between two or more parties."[4] The familiar principle of

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[1]Hurlburt, V. L., op. cit., pp. 85-90.

[2]Heady, E. O., op. cit., pp. 601-2.

[3]Hurlburt, V. L., op. cit., p. 96.

[4]Ibid., p. 87.

putting first things first is as important in forming management decisions for the renter or owner as it was for the owner-operator.[5]

It is with the foregoing concepts in mind that the following material is presented, in order to indicate how the tenant and the landlord use the opportunity cost principle and the discount theory to formulate their decisions.

The tenant will be interested in allocating his resources as the owner-operator did, with the purpose of achieving the highest possible net income.[6] This does not mean he will allocate the same amount of resources to any one line of operation, as the owner did. The particular amount he will set aside will be determined by the terms of the lease and the amount of capital he has.

If the tenant and the landlord have an agreement in which the variable costs are shared equally, they will apply the same amount of material to increase production that the owner-operator would have.[7]

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[5]Wallace, J. J., and Beneke, R. R., Managing the Tenant-Operated Farm, Ames: Iowa State University Press, 1960, p. 195.

[6]Heady, E. O., and Jensen, H. R., op. cit., p. 78.

[7]Ibid., pp. 566-7.

Applicability to the Problem

Consider the example in which a lease is drawn up for the farm discussed in the previous chapters. The landlord furnishes the use of the land and buildings and pays all fixed costs associated with their ownership, while the renter furnishes labor and all variable costs connected with the planting and harvesting of the crops except the cost of fertilizer. The expense of fertilizer is divided between them in the same proportion as crops are shared.

Using the same data derived in the previous farm plan where no fertilizer is applied, it was found that the first 60 pounds of ammonium nitrate increased the total yield on 50 acres of flax and oats by $187.80, and $390, respectively, at a cost of $120 for the fertilizer. Corn income was increased by $306 when $213 of commercial fertilizer was applied. These were the most profitable rates at which to apply fertilizer for the owner-operator. His opportunity costs of not investing in fertilizer for flax, corn and oats were $1.56, $1.44, and $3.25, respectively, for each dollar of fertilizer cost. These are the same opportunity costs which both the tenant and landlord have if each pays the same proportion of the fertilizer cost as he receives share of the crop. Each would invest his capital in the

practice returning the greatest amount above opportunity cost.[8] As the capital level increased, each would invest in the alternatives having the next higher opportunity cost as long as each paid his share of the fertilizer cost.

The next step is to determine whether or not the decision as to the profitability of fertilizer would be changed if terms of the lease were different. Assume a lease is agreed upon in which the landlord furnishes the land and buildings and pays the associated fixed costs, and he receives 2/5 of the total revenue from the crop. Meanwhile, the tenant furnishes all labor and variable expenses as he did in the previous lease, and he pays for all of the fertilizer.

Under this arrangement, the tenant would need to spend $120 on fertilizer for application on flax in order to obtain an increase in gross income for the farm of $187.80. Of this amount, he would receive $112.68. His investment would not be profitable. He would not apply 60 pounds of ammonium nitrate on an acre of flax. Assuming the variable factor of fertilizer is applied in smaller increments having a diminishing productivity effect on crop yields, the tenant

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[8] Ibid., p. 88.

may be able to find a lower level of fertilization which will return him a profit from fertilization.[9]

The result of lower fertilization will be to lower the total yield of flax for the farm from what it would have been under the foregoing lease. The farm is now less efficient than it would have been under the previous lease, as well as what it would have been under an owner-operator.[10]

What would the tenant find in the case of fertilizing corn? He would need to spend $213 on fertilizer for the 50 acres. The yield would be increased by 340 bushels. At $.90 per bushel, this amounts to an income change of $306. The tenant receives 60% of this, or $183.60. Once again he finds that not as much fertilizer will pay its way for him as it did for the owner-operator. Total farm efficiency will be lowered as he adjusts his input of fertilizer so that the last dollar spent on fertilizer will return a dollar's worth of product.[11]

The tenant would need to spend $120 on fertilizer for oats in order to increase revenue $390. Of this amount,

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[9]Heady, E. O., op. cit., Economics of Agricultural Production and Resource Use, p. 35.

[10]Heady, E. O., op. cit., "Marginal Productivity of Resources and Imputation of Shares for Cash and Share Rental Farms," p. 60.

[11]Heady, E. O., op. cit., Economics of Agricultural Production and Resource Use, p. 327.

he would receive $234. It turns out that this is the only crop on which it would be profitable for him to apply 60 pounds of ammonium nitrate fertilizer per acre.

For each crop, the gross returns from the farm are less than under a lease in which the tenant and owner share the fertilizer expenses equally.[12] Fertilization of oats is the only practice which both leases encourage and here the opportunity cost of buying fertilizer for oats is $3.25 for the tenant who shares expenses, compared to $1.95 for the tenant who pays for all the fertilizer costs.[13]

If the renter had a lease which designated him to receive 2/3 of gross returns from crop yields, while he furnished all of the fertilizer expenses, he would need to take another look at marginal returns and expenditures on fertilizer. On an investment of $120 for fertilizer to be used on flax, he would receive 2/3 of $187.60, or $123.94 from the additional yield. When a similar amount of fertilizer is applied on 50 acres of oats, a marginal return to the tenant of $257.40 can be realized. If he were to spend $213 on fertilizer for corn (60 pounds of 33-0-0 and 44 pounds of 0-45-0 per acre) he could have an additional

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[12]Hurlburt, V. L., op. cit., p. 88.

[13]Heady, E. O., and Jensen, H. R., op. cit., p. 79.

income of $260 or 2/3 of $390. Thus he would find it profitable to cut back on fertilization rates of corn while following the same practice the owner-operator did on oats and flax because marginal revenue is greater than marginal cost of fertilizer.[14] It has been demonstrated that practices which are profitable for one tenant may not be profitable for another. He needs to consider the additional inputs required of him and the returns earned by the increased investment.

On the farm plan calling for the utilization of 200 acres of native grass, the tenant need not be concerned about the number of years his lease continues. Native pasture can be grazed every year, thus permitting the tenant to plan from one year to the next with no need to allow for a period of establishment. He pays pasture rent of the same amount per acre, thus it can be considered as a fixed cost each year.

Pasture rent for native grass in Brookings County during 1961 averaged out to $4.30 per acre.[15] Land comparable to that located on the Agronomy Farm at South Dakota

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[14]Heady, E. O., op. cit., Economics of Agricultural Production and Resource Use, p. 191.

[15]Berry, R. L., op. cit., "Farm Tenancy Problems in South Dakota," p. 29.

State College is more productive than the average native pasture. In an effort to get at a more realistic value for its rental fee, it is assumed that $5.00 per acre is charged. The total pasture rent to the tenant is $1000 per year for the 200 acres of native pasture. This amount plus all variable costs connected with the production of yearling beef steers is the amount he needs to realize before renting this pasture.[16]

Using the same figures as were calculated for the farm plan in which the owner grazed steers on native pasture, it turns out that the tenant has a total cost of $10,692.[17] He expects to sell $10,710 worth of beef, which leaves him with a net profit for grazing steers on native grass of $18.00 per year.

Meanwhile, the landlord has a fixed cost on the native pasture (depreciation on buildings, real estate tax, interest on investment) of $808. His gross income of $1000 from the pasture section of the farm leaves him a return of $192 on that portion of the farm.

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[16] Heady, E. O., and Jensen, H. R., op. cit., p. 66.

[17] Derived by using the total pasture expenses of owner-operator from the budget calling for 200 acres of native grass ($10,500), subtracting fixed costs ($808), and adding rent ($1000).

Providing the tenant has sufficient capital, he can consider the practice of using improved pasture. These were all proven to be more profitable than native grass for the owner-operator with sufficient capital. Realizing returns above costs for improving pastures may, however, be uncertain for a tenant. The term of a tenant's lease needs to be as long as the life of an improved pasture in order for him to be certain of realizing the full benefits. An alternative for increasing his certainty would be a provision in the lease for paying him for his share of the value of the unrealized returns from the improved pasture.

Assume the terms of another proposed lease are the following: All fixed costs are paid by the landlord, and they come to a total of $808. In addition to these costs, the landlord pays all other costs for fertilizer during the year of establishment, plus grass and legume seed. The tenant pays all costs connected with the pasture and pays rent of $6.60 an acre each year, except during the initial year of establishment, when the opportunity cost of not renting it out for use as native pasture is carried by the landlord.

If the landlord and the tenant drew up a farm plan which included 200 acres of improved pasture consisting of intermediate wheatgrass and Vernal alfalfa, they would be working with a pasture, which, it is assumed, will have an expected productive life of four years after establishment.

Assume the landlord and the tenant are willing to enter into a five-year agreement. The problem becomes one of deciding which pasture would offer the highest possible return to the landlord and to the tenant. Discount equations need to be set up for both types of pastures. The returns from a five-year period need to be discounted for both parties, which will allow a comparison of the profitabilities of the pastures to be made.[18]

The landlord would forgo the rent which he could have obtained from leasing out the native grass during the year of establishment. Besides this cost, he has fixed costs and he pays for seed and fertilizer. The total comes to a net loss of $3160 during the first year of the pasture program. Each of the following four years he would receive $8.00 per acre in rental payments on the 200 acres for a total of $1600. After he subtracts the fixed costs, he has a net return of $792 on the pasture section of the farm. These figures, discounted to the present, indicate the landlord will lose $478 if he agrees to the foregoing lease.

$$PV=\frac{-\$3160}{1+.08}+\frac{\$792}{(1+.08)^2}+\frac{\$792}{(1+.08)^3}+\frac{\$792}{(1+.08)^4}+\frac{\$792}{(1+.08)^5}=-\$478$$

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[18]Boulding, K. E., op. cit., p. 86.

Another discount equation indicates the present value of the net returns from the same 200 acres if the owner leaves the land in native grass. He receives five dollars per acre as rent, which amounts to $1000 gross income. After subtracting the fixed cost of $808, he has $192 net income per year from the pasture rent.

$$PV=\frac{\$192}{1+.08}+\frac{\$192}{(1+.08)^2}+\frac{\$192}{(1+.08)^3}+\frac{\$192}{(1+.08)^4}+\frac{\$192}{(1+.08)^5}=\$769$$

The $192 discounted over five years gives a present value of $769. From the landlord's viewpoint, native pasture would be more profitable than the five-year improved pasture plan. The net income from the improved pasture leaves him with a present value of minus $478; whereas the discounted returns from native grass are $769 for a five-year period.

In order to determine whether it would be profitable for the renter to convert native grass to improved pasture, expected returns over the five-year period for both pastures need to be discounted. Net returns of the renter differ from those of the owner-operator used in previous discount equations. During the first year an added cost of $334 charged to repairs, depreciation and fuel for the year of establishment is incurred by the tenant. Add $18 to this, since this is the net return the tenant could have earned by grazing steers on native pasture. Thus, the total figure for the renter to discount the first year of pasture improvement is a minus $352.

He expects to sell $31,770 of beef each year except the first, from the 200 acres of pasture. From this amount he needs to subtract his costs. Rent is $8 per acre or $1600 each year on the pasture. This needs to be added to the total expenses attributed to the pasture phase in the Vernal and brome farm budget plan. The landlord pays fixed costs of $808 so this amount is subtracted from total expense. The final expenses for the tenant on each year's cattle production are $29,612, leaving him with a net income of $2,158 from the improved pasture.

The first year of the improved pasture program the renter incurs expenses, but realizes no revenue in returns. As a result he loses $352 during that year. The figures of minus $352 and $2158 are discounted over a five-year period.

$$PV=\frac{-\$352}{(1+.08)}+\frac{\$2158}{(1+.08)^2}+\frac{\$2158}{(1+.08)^3}+\frac{\$2158}{(1+.08)^4}+\frac{\$2158}{(1+.08)^5}=\$6347$$

His present value for a five-year program of Vernal alfalfa and bromegrass would be $6347. This figure is to be compared with the returns from five years of beef production by a tenant on native pasture.

The owner-operator netted $210 by grazing steers on native pasture; however, the renter is paying rent of $1000, which is $192 greater than the fixed costs of the owner-operator. By subtracting $192 from the $210 which was the

owner-operator's net income from the pasture, the renter finds he can earn $18 a year by grazing steers on native grass.

$$PV = \frac{\$18}{1+.08} + \frac{\$18}{(1+.08)^2} + \frac{\$18}{(1+.08)^3} + \frac{\$18}{(1+.08)^4} + \frac{\$18}{(1+.08)^5} = \$70$$

His present value of grazing steers on native pasture for five years is $70. This compared to the present value of $6,347 for improved pasture gives Vernal alfalfa and brome the big edge in profitability insofar as the renter is concerned.

If the landlord and renter are willing to enter into a ten-year lease agreement, they may desire to choose a different type of improved pasture which has longer productivity and compare its present value to that of native pasture over the same period of time. The discount equations would need to be worked for the net incomes of each party involved for both types of pastures.

The landlord would receive the same net income of minus $3,160 during the initial year of the improved pasture program which he received for the five-year pasture program. He would also have the same net income of $792 each of the nine years following establishment of the pasture.

$$PV=\frac{-\$3160}{1+.08}+\frac{\$792}{(1+.08)^2}+\frac{\$792}{(1+.08)^3}+\frac{\$792}{(1+.08)^4}+\frac{\$792}{(1+.08)^5}+$$

$$\frac{\$792}{(1+.08)^6}+\frac{\$792}{(1+.08)^7}+\frac{\$792}{(1+.08)^8}+\frac{\$792}{(1+.08)^9}+\frac{\$792}{(1+.08)^{10}}=\$1720$$

The discounted net incomes from the ten-year improved pasture program have a present value of $1,720 for the landlord. In order to compare the present value of the net incomes he would receive from native pasture with that of improved pasture over the same length of time, the landlord's anticipated net revenue from native pasture must be discounted.

Net returns to be used in the equation for each of the ten years are the same as those used when the present value of five years of native pasture for the landlord was determined.

$$PV=\frac{\$192}{(1+.08)}+\frac{\$192}{(1+.08)^2}+\frac{\$192}{(1+.08)^3}+\frac{\$192}{(1+.08)^4}+\frac{\$192}{(1+.08)^5}+$$

$$\frac{\$192}{(1+.08)^6}+\frac{\$192}{(1+.08)^7}+\frac{\$192}{(1+.08)^8}+\frac{\$192}{(1+.08)^9}+\frac{\$192}{(1+.08)^{10}}=$$

$1,301

The landlord would have a present value of $1,720 and $1,301, respectively, for ten-year programs of improved pasture and native pasture when renting improved pasture for $5 per acre.

Two pasture mixtures are assumed to possess a sufficient length of productivity to warrant consideration for

the long-term pasture program. Teton alfalfa and brome-grass, as well as Teton alfalfa and intermediate wheatgrass, are mixtures which are assumed to remain productive for nine years after establishment.

From the farm budgets, it has been indicated, that a yearly gross income of $31,240 can be obtained from Teton and brome pasture, compared to $31,630 from Teton and intermediate wheatgrass.

The expected incomes of the renter from the improved pastures need to be determined. A total expense for the improved pasture system of $28,820 was incurred by the owner-operator. The rental fee of $1,600 is added to this for the renter; however, he does not bear the fixed costs of $808 or seed and fertilizer costs of $588. His total expenses turn out to be $28,830 for both kinds of improved pastures. This leaves the renter with a net income each year, except for the year of establishment, of $2,410 from Teton and brome and $2,560 from Teton and intermediate wheatgrass.

The present value of the returns to the renter for the three types of pastures are determined by discounting his net returns for the ten years involved. He bears a net income of minus $352 during the first year for each of the improved pasture plans as he did in the previous five-year improved pasture plan. During each of the succeeding years

he realizes, as mentioned, a net income of $2,410 on Teton and brome and $2,560 on the Teton and intermediate pastures. On the native pasture, he nets $18 each of the ten years. These net incomes discounted return to him over a ten-year period: $14,699 from the Teton and intermediate wheatgrass, $13,818 from the Teton and bromegrass and $120 from the native grass.

The foregoing discounting equations indicate the landlord's present value of an improved pasture over five years is a poor investment financially for him. He would be better off to leave the land in native pasture. Over a ten-year period, improved pastures have a greater present value than native grass at the assumed rental fees.

Renters would make better returns on their investment by renting improved pastures rather than native grass. Both the long-term improved pastures and the five-year improved pastures offer the renter greater present values than native pastures.

CHAPTER VI

RESULTS OF STUDY

Summary and Conclusions

Basically, this study revolves around the allocation of various levels of expenditures among farm practices with the goal of obtaining the highest possible net revenue. The economic principles of opportunity cost and the discount theory are used in determining which practice is most profitable for both owner-operators and tenants.

Special emphasis is placed on comparing the expected net revenues from improved pastures with that of native pastures. Gains made by yearling beef steers are used as the unit of measurement in order to determine the gross income. Costs are calculated by assuming a price for each commodity and using these in working out farm plans in budgetary form for each of the pastures considered.

The highest returns are shown per unit of variable cost for planting flax, oats and corn. An owner-operator operation having very limited capital would spend his first $235 on flax, the next $172 on oats, and the next $336 on corn.

More capital would allow the operator to buy fertilizer, which returns higher dividends than any of the pasture

projects. When applying fertilizer at the rate of 60 pounds of ammonium nitrate per acre on all of the crop land plus 44 pounds of superphosphate per acre on corn, it is most profitable to fertilize in the following order: oats, flax and corn.

A total of $1,192 would be sufficient to pay for the variable costs of raising 50 acres of oats, 50 acres of flax, and 50 acres of corn, according to the previously mentioned practices. Capital beyond this amount is to be invested in yearling beef steers to be grazed on the native pastures.

With a capital of $10,666 available, $1,192 is allocated to pasture production and $9,474 used for the purpose of grazing native pasture. Additional capital would be invested in the open market until $12,882 are available. This would be sufficient to allow 50 acres of soybean and sudangrass to replace 50 acres of native grass and pay the additional variable expenses of utilizing the two types of pastures. The sudangrass and soybean pasture adds $310 to the net income.

Capital beyond $12,882 is invested in the open market until $30,776 are available. It is then advantageous to make use of any one of the four improved pastures. Each

has a marginal return on variable costs above those of the pastures previously mentioned.

Over a five-year period, the present value of improved pasture is higher than that of the native pasture. Fifty acres of mixtures of intermediate wheatgrass and Vernal alfalfa has a present value of $1,891, while the same size native pasture has a present value of $210.94.

On a ten-year pasture plan, Teton and brome, which is assumed to have a productivity span of nine years, has a present value of $3,151. A pasture which needs to be reseeded twice in this period, such as Vernal and brome, has a present value of $2,873. These values stress the importance of choosing the correct pasture to fit the farm plan of the future; for even though the Vernal and intermediate pasture outyields the Teton and intermediate pasture, the latter pasture has the highest present value. This is the case because only one year of the term has a loss of income for the Teton and intermediate; whereas Vernal and intermediate needs to be established twice.

Tenants seeking a maximum net income for themselves may not follow the identical practices that the owner-operator did. The terms of the lease are the deciding factor in determining whether or not the tenant and the owner-operator follow the same cropping practices. If the

landlord and the tenant share the fertilizer costs in the same manner as they divide the total yield, the same amount of fertilizer is as profitable for the tenant as for the owner-operator. However, if the tenant pays all the fertilizer costs and receives 60% of the crop, oats is the only crop which returns more than the cost of fertilizer when 60 pounds of ammonium nitrate is added per acre.

When pasture is rented for cash at the rate of eight dollars per acre for improved pasture and five dollars per acre for native pasture, a renter finds all improved pastures to be more profitable than native pasture if he pays only the cost of establishing the pasture.

The landlord finds the profitability of pastures depends on the type of improved pasture considered. Native pasture is more valuable for the landlord than a pasture which needs reseeding every five years. On the other hand, an improved pasture which lasts nine years will yield more net revenue to the landlord than native pasture during the same period of time.

Need for Further Study

A better comparison can be made of the value of improved pastures. This will be possible when the experimental pasture tests at South Dakota State College have

been completed. It may be that some pasture mixture will have a productive period exceeding the assumptions used in this paper. The yields from some of these pastures may vary a great deal due to climatic conditions while others are not affected so severely. These are problems which only further study can answer.

As improved pastures and crops are competitive for the use of land, it would be useful to compare the expected income from crops and the expected income from improved pastures. The element of risk could play a determining part in how much advantage one would have over the other.

The allocation of capital could be stressed more as an important farm practice if yields were used where many different levels of fertilizer are applied on both crops and pastures.

Comparisons of improved and unimproved pastures on different soil types and in different areas of the state are needed for the benefit of wider groups of farmers.

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APPENDIXES

APPENDIX I

Specific Assumptions Used in the Analysis

The following assumptions are made:

1. Farm size remains constant.
2. Pasture size is 200 acres in each farm plan.
3. Grain crops are grown on 150 acres in each farm plan.
4. Flax, oats and corn are the only cash crops.
5. All grain is sold as cash crop.
6. Yearling steers are the only class of livestock.
7. Prices are as given in tables A-1 and A-2.
8. Yields do not vary due to climate.
9. Vernal alfalfa and bromegrass as well as Vernal alfalfa and intermediate wheatgrass have a productive life of four years.
10. Teton alfalfa and bromegrass as well as Teton alfalfa and intermediate wheatgrass have a productive life of nine years.
11. No charge is made for operator labor.
12. Yields are as given in tables A-2 and A-3.
13. Management is adequate to carry out the specified practices.
14. Capital is adequate to meet the costs of the various plans.

15. Agronomy Farm yields are suitable for comparison. However, good fertility practices followed means fertilizer response may not be typical of farm results.

Table A-1 Costs Used for Budget Analysis

Inventory value	½ of new cost
Depreciation, machinery	10% of inventory
Depreciation, buildings	3% of inventory
Repairs, machinery	4% of inventory
Repairs, buildings	3½% of inventory
Real estate taxes	20 mills on inventory
Personal property taxes	20 mills on inventory
Insurance	1½% of inventory
Interest, real estate	5½% of inventory
Interest, short term	7% of inventory
Land value (assessed)	$100 per acre
Fertilizer	
33-0-0	$80 per ton
0-45-0	$85 per ton
Seed	
Alfalfa	$.38 per pound
Brome	$.38 per pound
Intermediate wheatgrass	$.38 per pound
Soybeans	$2.50 per bushel
Sudangrass	$.14 per pound
Corn	$12.40 per bushel
Cattle	
buy yearling steers, 550 lbs.	$27.40 per cwt.
sell yearling steers, 800 lbs.	$23.48 per cwt.
Fuel and grease	$.60 per hour of tractor use

Table A-2 Assumed Prices and Yields of Grain in Bushels per Acre

	Price per Bushel	Yield Without Fertilizer	Yield With Low* Amount of Fertilizer	Yield with Medium** Amount of Fertilizer
Flax	$3.13	11.6	12.8	12.2
Corn	.90	45.7	52.5	53.6
Oats	.50	48.9	64.5	67.5

*Sixty pounds of ammonium nitrate on all crops plus 44 pounds of superphosphate on the corn.

**One hundred and twenty pounds of ammonium nitrate on all crops plus 44 pounds of superphosphate on the corn.

Table A-3 Production of Beef From Different Pastures (Based on South Dakota Agricultural Experiment Station results)

Pasture Type	Pounds of Beef Produced per Acre*
Vernal Alfalfa and Intermediate Wheatgrass	212.1
Vernal Alfalfa and Bromegrass	211.8
Teton Alfalfa and Intermediate Wheatgrass	208.8
Teton Alfalfa and Brome	205.5
Native Grass	53
Soybeans and Sudangrass	118

*Using Yearling Steers

APPENDIX II

Table A-4 Summary of Costs and Returns from Different Budgets Using Various Pastures

	Vernal Alfalfa and Brome	Teton Alfalfa and Brome	Vernal Alfalfa and Intermediate Wheatgrass	Teton Alfalfa and Intermediate Wheatgrass	Soybean and Sudangrass	Native Pasture
Pasture Costs and Returns						
Livestock Sales	$31,770	$31,240	$31,780	$31,630	$11,830	$10,710
Fixed Costs	808	808	808	808	808	808
Variable Costs	28,012	28,012	28,012	28,012	10,502	9,692
Net Sales	2,950	2,420	2,960	2,810	520	210
Grain Costs and Returns						
Total Grain Sales	5,609	5,609	5,609	5,609	5,609	5,609
Fixed Costs	760	760	760	760	760	760
Variable Costs	951	951	951	951	951	976
Net Sales	3,898	3,898	3,898	3,898	3,898	3,873
Total Farm Net Income	6,848	6,318	6,858	6,708	4,418	4,083

Table A-5 Budget Summary for Farm Plan Using 200 Acres of Vernal Alfalfa and Bromegrass Pasture and 50 Acres Each of Corn, Oats and Flax.

Pasture		Crops	
Gross Sales	$31,770	Gross Sales	$5609
Fixed Expenses		Fixed Expenses	
Real Estate Tax	178	Real Estate Tax	308
Interest on Investment	412	Interest on Investment	164
Depreciation	218	Depreciation	288
Total Fixed Costs	808	Total Fixed Costs	760
Variable Costs		Variable Costs	
Cattle Purchase	25,468		
Veterinarian and Salt	199		
Short Term Interest	970	Short Term Interest	79
Personal Property Taxes on Cattle	510		
Personal Property Taxes on Machinery	16	Personal Property Taxes on Machinery	48
Insurance	143	Insurance	21
Seed	228	Seed	99
Fertilizer	360	Fertilizer	333
Fuel and Repairs	108	Fuel and Repairs	371
Total Variable Costs	28,012	Total Variable Costs	951
Net Returns	2,950	Net Returns	3,898

Table A-6 Budget Summary for Farm Plan Using 200 Acres of Teton Alfalfa and Bromegrass Pasture and 50 Acres Each of Corn, Oats and Flax.

Pasture		Crops	
Gross Sales	$31,240	Gross Sales	$5,609
Fixed Expenses		Fixed Expenses	
Real Estate Tax	178	Real Estate Tax	308
Interest on Investment	412	Interest on Investment	164
Depreciation	218	Depreciation	288
Total Fixed Cost	808	Total Fixed Cost	760
Variable Costs		Variable Costs	
Cattle Purchase	25,468		
Veterinarian and Salt	199		
Short Term Interest	970	Short Term Interest	79
Personal Property Taxes on Cattle	510		
Personal Property Taxes on Machinery	16	Personal Property Taxes on Machinery	48
Insurance	143	Insurance	21
Seed	228	Seed	99
Fertilizer	360	Fertilizer	333
Fuel and Repairs	108	Fuel and Repairs	371
Total Variable Costs	28,012	Total Variable Costs	951
Net Revenue	2,420	Net Revenue	3,898

Table A-7 Budget Summary for Farm Plan Using 200 Acres of Vernal Alfalfa and Intermediate Wheatgrass Pasture and 50 Acres Each of Corn, Oats and Flax.

Pasture		Crops	
Gross Sales	$31,780	Gross Sales	$5,609
Fixed Expenses		Fixed Expenses	
Real Estate Tax	178	Real Estate Tax	308
Interest on Investment	412	Interest on Investment	164
Depreciation	218	Depreciation	288
Total Fixed Cost	808	Total Fixed Cost	760
Variable Costs		Variable Costs	
Cattle Purchase	25,468		
Veterinarian and Salt	199		
Short Term Interest	970	Short Term Interest	79
Personal Property Taxes on Cattle	510		
Personal Property Taxes on Machinery	16	Personal Property Taxes on Machinery	48
Insurance	143	Insurance	21
Seed	228	Seed	99
Fertilizer	360	Fertilizer	333
Fuel and Repairs	108	Fuel and Repairs	371
Total Variable Cost	28,012	Total Variable Cost	951
Net Returns	2,960	Net Returns	3,898

Table A-8 Budget Summary for Farm Plan Using 200 Acres of Teton Alfalfa and Intermediate Wheatgrass Pasture and 50 Acres Each of Corn, Oats and Flax.

Pasture		Crops	
Gross Sales	$31,630	Gross Sales	$5,609
Fixed Expenses		Fixed Expenses	
Real Estate Tax	178	Real Estate Tax	308
Interest on Investment	412	Interest on Investment	164
Depreciation	218	Depreciation	288
Total Fixed Costs	808	Total Fixed Costs	760
Variable Costs		Variable Costs	
Cattle Purchase	25,468		
Veterinarian and Salt	199		
Short Term Interest	970	Short Term Interest	79
Personal Property Taxes on Cattle	510		
Personal Property Taxes on Machinery	16	Personal Property Taxes on Machinery	48
Insurance	143	Insurance	21
Seed	228	Seed	99
Fertilizer	360	Fertilizer	333
Fuel and Repairs	108	Fuel and Repairs	371
Total Variable Costs	28,012	Total Variable Costs	951
Net Returns	2,810	Net Returns	3,898

Table A-9 Budget Summary for Farm Plan Using 50 Acres of Sudangrass and Soybean Pasture, 150 Acres of Native Pasture and 50 Acres Each of Corn, Oats and Flax.

Pasture		Crops	
Gross Sales	$11,310	Gross Sales	$5,609
Fixed Expenses		Fixed Expenses	
Real Estate Tax	178	Real Estate Tax	308
Interest on Investment	412	Interest on Investment	164
Depreciation	218	Depreciation	288
Total Fixed Costs	808	Total Fixed Costs	760
Variable Costs		Variable Costs	
Cattle Purchase	9,340		
Veterinarian and Salt	68		
Short Term Interest	166	Short Term Interest	79
Personal Property Taxes on Cattle	360		
Personal Property Taxes on Machinery	16	Personal Property Taxes on Machinery	48
Insurance	50	Insurance	21
Seed	174	Seed	99
Fertilizer	220	Fertilizer	333
Fuel and Repairs	108	Fuel and Repairs	371
Total Variable Costs	10,502	Total Variable Costs	951
Net Returns	520	Net Returns	3,898

Table A-10 Budget Summary for Farm Plan Using 200 Acres of Native Pasture and 50 Acres Each of Corn, Oats and Flax.

Pasture		Crops	
Gross Sales	$10,710	Gross Sales	$5,609
Fixed Expenses		Fixed Expenses	
Real Estate Tax	178	Real Estate Tax	308
Interest on Investment	412	Interest on Investment	164
Depreciation	218	Depreciation	288
Total Fixed Costs	808	Total Fixed Costs	760
Variable Costs		Variable Costs	
Cattle Purchase	9,343		
Veterinarian and Salt	30		
Short Term Interest	166	Short Term Interest	79
Personal Property Taxes on Cattle	128		
Personal Property Taxes on Machinery	00	Personal Property Taxes on Machinery	64
Insurance	25	Insurance	30
Seed	00	Seed	99
Fertilizer	00	Fertilizer	333
Fuel and Repairs	00	Fuel and Repairs	371
Total Variable Cost	9,692	Total Variable Cost	976
Net Returns	210	Net Returns	3,873